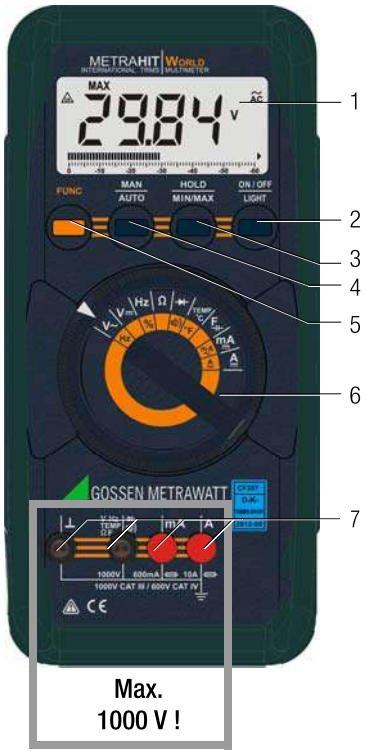
Operating Instructions

GOSSEN METRAWATT

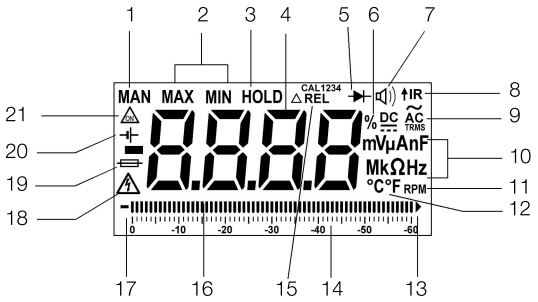
# METRAHIT | WORLD

## International TRMS Multimeter

3-349-529-03
10/6.17




| | | |
|---|---|---|
| 1 | **Display** (LCD) | |
| 2 | **ON / OFF \| Light** | Key for ON / OFF and display illumination ON / OFF |
| 3 | **HOLD** | Key for the following functions: save measured value, delete and MAX-MIN |
| 4 | **MAN / AUTO** | Key for manual measuring range selection |
| 5 | **FUNC** | Key for selecting ranges or functions |
| 6 | **rotary selector switch** | for measuring functions |
| 7 | **Connector jacks** | |




**Symbols used in the Digital Display**

1 MAN: manual measuring range selection is active
2 MAX/MIN value storage
3 HOLD: display memory, “freeze” measured value
4 Digital display with decimal point and polarity display
5 Diode measurement selected
6 Display Duty Cycle Measurement
7 appears when acoustic signal is active
8 Selected type of current
9 interface active
10 Unit of measure
11 Unit of measure °C / °F for temperature measurement
12 **R**otation **P**er **M**inute measurement selected
13 Triangle appears: indicates overranging
14 Pointer for analog display
15 Δ REL: relative measurement with reference to offset
16 Scale for analog display
17 Indicates that the negative analog display range has been exceeded
18 Warning regarding dangerous voltage: > 40 V AC / 60 DC
19 Display in case of defective fuse
20 Low battery display
21 Symbol for continuous duty

**Standard Equipment**

1 TRMS-digital multimeter
1 Protective rubber holster
2 1.5 V AA size batteries
1 Set of measurement cables KS17-2
1 DAkkS calibration certificate
1 Short-form operating instructions

Table of Contents



## 1 Safety Features and Precautions

You have selected an instrument which provides you with a high level of safety.

This instrument fulfills the requirements of the applicable EU guidelines and national regulations. We confirm this with the CE marking. The relevant declaration of conformity can be obtained from GMC-I Messtechnik GmbH.

The analog-digital multimeter is manufactured and tested in accordance with safety regulations IEC 61010–1:2010/ DIN EN 61010–1:2011/VDE 0411–1:2011. When used for its intended purpose, safety of the operator, as well as that of the instrument, is assured. Their safety is however not guaranteed, if the instrument is used improperly or handled carelessly.

**In order to maintain flawless technical safety conditions, and to assure safe use, it is imperative that you read the operating instructions thoroughly and carefully before placing your instrument into service, and that you follow all instructions contained therein.**

In the interest of your own safety and in order to protect the instrument, the multimeter is equipped with an automatic socket blocking mechanism. This mechanism is linked to the function selector switch and only allows access to those jacks which are actually required for the selected function. It also prevents the user from turning the selector switch to impermissible functions after the measurement cables have already been plugged in.

**Observe the following safety precautions:**

- The instrument may only be operated by persons who are capable of recognizing contact hazards and taking the appropriate safety precautions. Contact hazards exist anywhere, where voltages of greater than 33 $V_{RMS}$ may occur.
- Avoid working alone when taking measurements which involve contact hazards. Be certain that a second person is present.
- **Maximum allowable voltage** between any of the connector jacks and earth **is 1000 V, category III or 600 V CAT IV.** Nominal voltage at the system may not exceed 600 V. For the application of measuring cables see chap. 17.2.

Voltage measurement may only be performed with the selector switch set to the V= or the V~ position.

- Be prepared for the occurrence of unexpected voltages at devices under test (e.g. defective devices). For example, capacitors may be dangerously charged.
- Make certain that the measurement cables are in flawless condition, e.g. no damage to insulation, no interruptions in cables or plugs etc.
- No measurements may be made with this instrument in electrical circuits with corona discharge (high-voltage).
- Special care is required when measurements are made in HF electrical circuits. Dangerous pulsating voltages may be present.
- Measurements under moist ambient conditions are not permitted.
- Be absolutely certain that the **measuring ranges are not overloaded beyond their allowable capacities**. Limit values can be found in the “Measuring Ranges” table in chapter 14 “Characteristic Values”.
- All current measuring ranges are protected with fuses. Maximum allowable voltage for the measuring current circuit is 1000 V in all “mA” and “A” ranges.

**Warning!**

The standard instrument may not be operated in explosive atmosphere, or connected to intrinsically safe electrical circuits.
There is a special type **World IS** which is certified for this application.

**Measuring Categories and their Meaning per IEC 61010-1**

| CAT | Definition |
|---|---|
| I | Measurements in electrical circuits not directly connected to the mains system:<br>*e. g. power systems in motor vehicles or aeroplanes, batteries ...* |
| II | Measurements in electrical circuits directly connected to the low-voltage system:<br>*via plug, e.g. in households, offices, laboratories ...* |
| III | Measurements in facility installations:<br>*stationary consumers, distributor connections, devices attached to a distributor* |
| IV | Measurements at the source of low-voltage installations:<br>*Meters, main terminal, primary overcurrent protection devices* |

The measurement category and the relevant maximum rated voltage (e. g. 1000 V CAT III) which are shown on the instrument casing apply to your measuring instrument.

**Meanings of symbols on the instrument:**

Warning concerning a source of danger (attention: observe documentation)

Earth terminal

Continuous, doubled or reinforced insulation

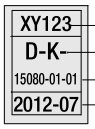
This device may not be disposed of with the trash. Further information regarding the WEEE mark can be accessed on the Internet at

search term ’WEEE’.

Indicates EC conformity

CAT III / IV **Maximum allowable voltage** between the connector jacks and earth is **1000 V, category III or 600 V category IV.**

**DAkkS Calibration Upon Request:**




XY123 — Consecutive number
D-K- — Deutsche Akkreditierungsstelle GmbH – calibration laboratory
15080-01-01 — Registration number
2012-07 — Date of calibration (year - month)

**Repair, Parts Replacement and Balancing**

When the instrument is opened, voltage conducting parts may be exposed. The instrument must be disconnected from the measuring circuit before the performance of repairs, the replacement of parts or balancing. If balancing, maintenance or repair of a live open instrument is required, this may only be carried out by trained personnel who are familiar with the dangers involved.

**Defects and Extraordinary Strains**

If it may be assumed that the instrument can no longer be operated safely, it must be removed from service and secured against unintentional use.
Safe operation can no longer be relied upon:

- If the device demonstrates visible damage
- If the instrument no longer functions
- After lengthy periods of storage under unfavorable conditions (e.g. humidity, dust, temperature), see ambient conditions on page 16

## 2 Initial Start-Up

### Battery

Your instrument is supplied with two 1,5 V AA size batteries in accordance with IEC LR 6, and is ready for operation. **Be sure to refer to chapter 15.1 "Battery", before initial start-up, or after your device has been in storage for a lengthy period of time.**

### Switching the Instrument On

➪ Press the **ON / OFF** key.
Power-up is acknowledged with an acoustic signal. All of the segments at the liquid crystal display (LCD) are illuminated shortly. The LCD is shown in the diagram on page 2.

**Note!**
Electrical discharge and high frequency interference may cause incorrect displays to appear, and may disable the measuring sequence. In such cases, switch the instrument off and back on again in order to reset. If the problem persists, briefly dislodge the battery from the connector contacts.

**Disconnect the instrument from the measuring circuit before opening** and refer to chapter 15 "Maintenance"!

### Automatic Shutdown

The instrument switches itself off automatically if neither one of the keys nor the rotary selector switch are activated for a period of approximately 15 minutes.

### Disabling Automatic Shutdown

The instrument can be set to continuous duty. Press the **FUNC** key and the **ON / OFF** key simultaneously when switching the instrument on to this end. Continuous duty is indicated at the LCD by means of the ⚠ symbol.

### Switching the Instrument Off

Press the **ON / OFF** key.

## 3 Selecting Measuring Functions and Measuring Ranges

The function selector switch is linked to the automatic socket blocking mechanism, which only allows access to two connector jacks for each function. Be certain to remove the appropriate plug from its respective jack before switching to and from the "mA" or the "A" function. The socket blocking mechanism prevents the user from inadvertently turning the selector switch to impermissible functions after the measurement cables have been plugged in to the instrument.

### 3.1 Automatic Measuring Range Selection

The multimeter is equipped with automatic measuring range selection for all ranges except the 600 mV ~ range. Auto-ranging is active as soon as the instrument is switched on. The instrument automatically selects the measuring range which allows for highest possible resolution of the applied quantity.

**The instrument is automatically switched to:**

| | | |
|---|---|---|
| – The next highest range | at typically | ± (6039 digits + 1 digit) |
| – The next lowest range | at typically | ± (560 digits – 1 digit) |

### 3.2 Manual Measuring Range Selection

Auto-ranging can be deactivated and measuring ranges can be selected manually in accordance with the following table.
Manual operation is deactivated by pressing and holding the **MAN / AUTO** key (approx. 1 s), by activating the **rotary selector switch**, or by switching the instrument off and then back on again.
If the instrument is switched back to auto-ranging in the 600 mV ~ range, the respective range or 6 V ~ is selected automatically.

| ⇓ AUTO/ MAN (4) | Function | Acknowledgement: Display | Acknowledgement: Acoustic Signal |
|---|---|---|---|
| brief | Manual mode active: utilized measuring range is fixed | MAN (10) | 1 x |
| brief | Range switching sequence for:<br>V ⎓: 600 mV → 6 V → 60 V → 600 V → 1000 V → 600 mV ...<br>V ~: 6 V → 60 V → 600 V → 600 mV → 6 V → 1000 V...<br>mA ⎓: 60 mA → 600 mA → ...<br>mA ~: 60 mA → 600 mA → ...<br>A ⎓: 6 A → 10 A → 6 A ...<br>A ~: 6 A → 10A → 6 A ...<br>Ω: 60 MΩ → 600 Ω → 6 kΩ → 60 kΩ → 600 kΩ → 6 MΩ → 60 MΩ ... | MAN (10) | 1 x |
| long | Return to automatic range selection | — | 2 x |

### 3.3 Quick Measurements

Measurements performed using a suitable fixed measuring range are executed more quickly than those which utilize automatic range selection. Quick measurement is made possible with the following two functions:

- **Manual measuring range selection**, i.e. selection of the measuring range with best resolution (see chapter 3.2)

or

- With the **HOLD function** (see chapter 5). In this way, the correct measuring range is selected automatically after the first measurement and all further measurements are executed more quickly.

The selected measuring range remains active for the subsequent series of measurements with these two functions.

### 3.4 Relative Measurement Δ REL

A reference value for relative measurements can be stored to memory with the keys **MAN / AUTO** and **HOLD**.
The applicable reference or correction value is substracted individually for the respective measuring function as an offset from all subsequent measurements, and remains in memory until deleted, or until the multimeter is switched off.
Reference value setting is only possible for the respective manually selected measuring range.

**Setting the Reference Value**

- ➪ Plug the measuring cable into the instrument and measure a reference value.
- ➪ Press the **MAN / AUTO** key and the **HOLD** key simultaneously.
  The instrument acknowledges storage of the reference value with an acoustic signal, and the Δ **REL** symbol appears at the LCD. The value measured at the moment the keys are pressed serves as a reference value.
- ➪ The reference value can be cleared by once again pressing the **MAN / AUTO** and **HOLD** keys.

**Note!**
Relative measurement effects the digital display only. Relative measurement is not active during overflow. In the case of relative measurement, quantities may also appear as negative values.

## 4 LCD

### 4.1 Digital Display

The measured value with decimal and plus or minus sign appears at the digital display. The selected unit of measure and the current type are displayed as well. A minus sign appears to the left of the value during the measurement of zero-frequency quantities, if the plus pole of the measured quantity is applied to the "⊥" input. "OL" is displayed if the upper range limit of 6039 is exceeded (or 1999 in the ⊣⊢ range).
The digital display is refreshed twice per second during V, A and Ω measurements.

### 4.2 Analog Display

The analog display with simulated pointer and the same dynamic performance as a moving-coil mechanism is refreshed 20 times per second during V, A and Ω measurements. This display is especially advantageous for observing measured value fluctuation, and for balancing procedures.
The analog display has its own polarity indicator. If the measured value exceeds the display range, polarity at the analog display is switched after approximately 0.7 seconds. Overranging is indicated by the triangle at the right (> 6039 digits).

### 4.3 Display Illumination

After the instrument has been switched on, background illumination can be activated by briefly pressing the **ON / OFF | LIGHT** key. Illumination is switched back off by once again pressing the same key, or automatically after approximately 1 minute.

## 5 Measured Value Memory "HOLD"

By pressing the **HOLD** key, the currently displayed measurement value can be "frozen" in the display, and "Hold" is simultaneously indicated. Automatic shutdown is deactivated during this process.
The Hold display is deactivated if:

- the **HOLD** key is pressed and held
- the **rotary selector switch** is activated
- the **FUNC** multifunction key is pressed for a change of function, e.g. AC → Hz.

## 6 Saving Minimum or Maximum Values "MIN/MAX" Hold

Minimum and maximum measured values applied to the measuring instrument's input after the MAX/MIN function has been activated, can be "frozen" at the display with the MAX/MIN function. The most important use of this function is the determination of minimum or maximum values during long-term measured quantity observation.

- ➪ Select the measurement function with the **rotary selector switch** and, if appropriate, with the **FUNC** multifunction key.
- ➪ Connect the device under test as described in the following measurement instructions.
- ➪ Press the **HOLD** key twice.
  MAX is displayed. The measuring instrument continually updates and digitally displays the largest occurring measured value.
- ➪ Press the **HOLD** key.
  MIN is displayed. The measuring instrument continually updates and digitally displays the lowest occurring measured value. Pressing **HOLD** once more switches this function back to MAX.
- ➪ Press and hold the **HOLD** key for approx. 2 seconds, to quit the HOLD function.

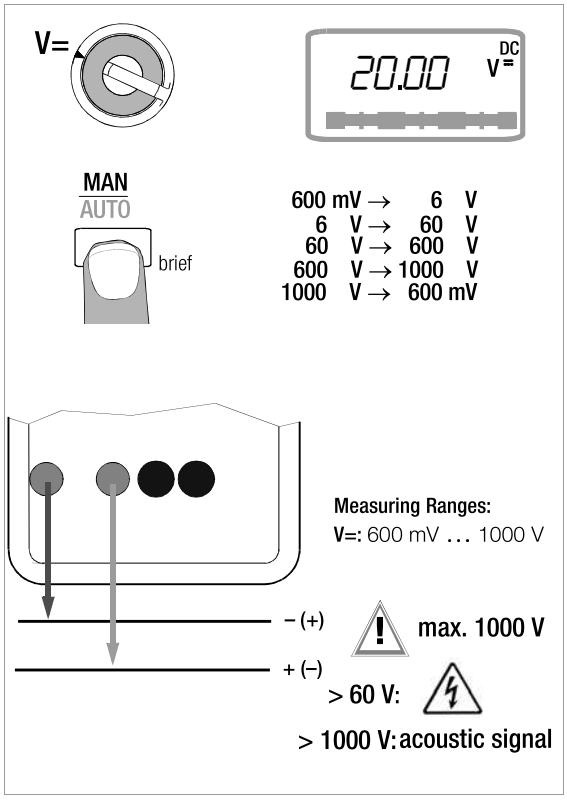

* range selection is not provided for with MAN + MIN / MAX

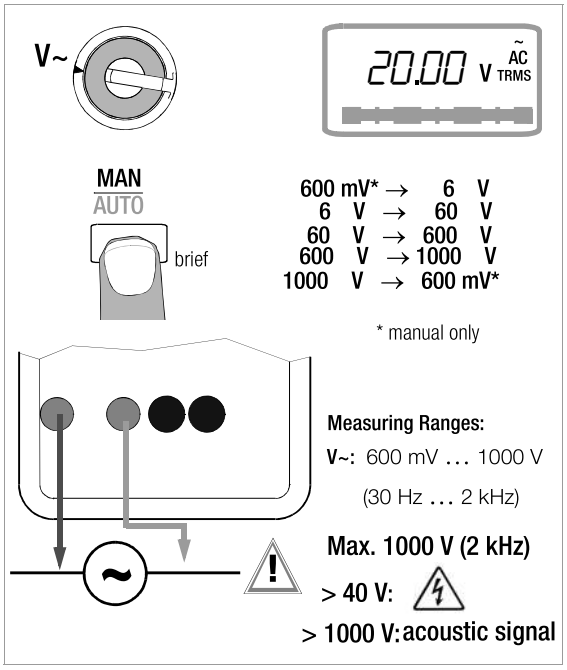
## 7 Voltage Measurement

- Depending upon the voltage to be measured, set the **rotary selector switch** to V ~ or V ⎓.
- Connect the measurement cables as shown. The "⊥" connector jack should be grounded.

**Note!**
The 600 mV ~ measuring range can only be selected manually with the **MAN / AUTO** key.
If the measured value exceeds 60 V DC or 40 V AC the symbol ⚠ appears at the display.
An intermittent acoustic signal warns the operator if the measured value exceeds the upper range limit value of 1000 V in the 1000 V range.

**Attention!**
**Make sure than none of the current measuring ranges** (neither "mA" nor "A") **are activated** when connecting the multimeter for the performance of voltage measurements! If fuse trip limits are exceeded as a result of operator error, both the operator and the instrument are in danger!




**Zero Balancing Δ REL in the V AC und V DC Measuring Range**

You can select the reference point in the V AC and V DC measuring range:

- Plug the measuring cables into the instrument and connect the free ends to each other.
- After selecting the measuring range, briefly press the two **HOLD** and **MAN / AUTO** keys.

The instrument acknowledges zero balancing with an acoustic signal and „0" (+ 1 digit) and Δ REL appears at the LCD, depending on the measuring range. The voltage displayed at the moment the key is pressed is automatically substracted from all subsequent measured values.

Zero balancing can be deleted:

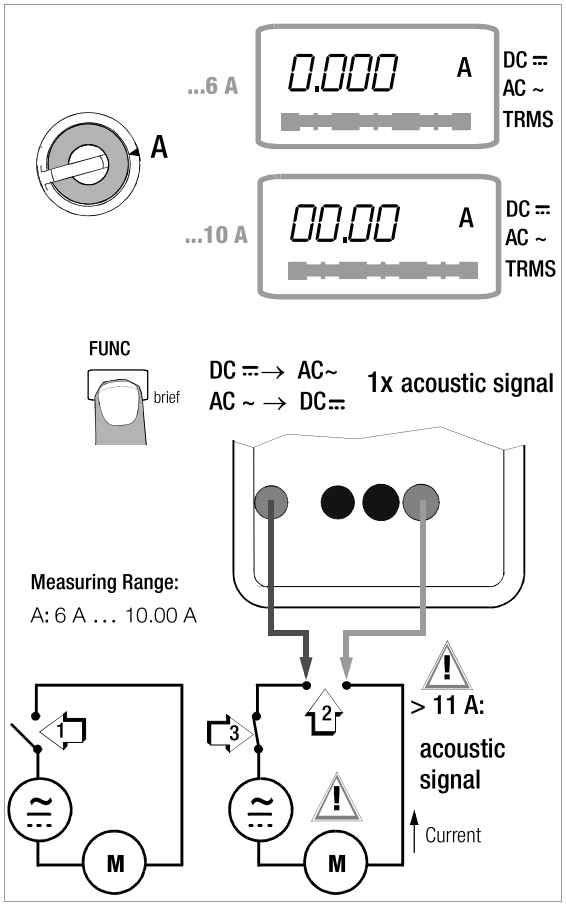
– by briefly pressing the **MAN / AUTO** key, which is acknowledged with an acoustic signal,
– by switching the instrument off.

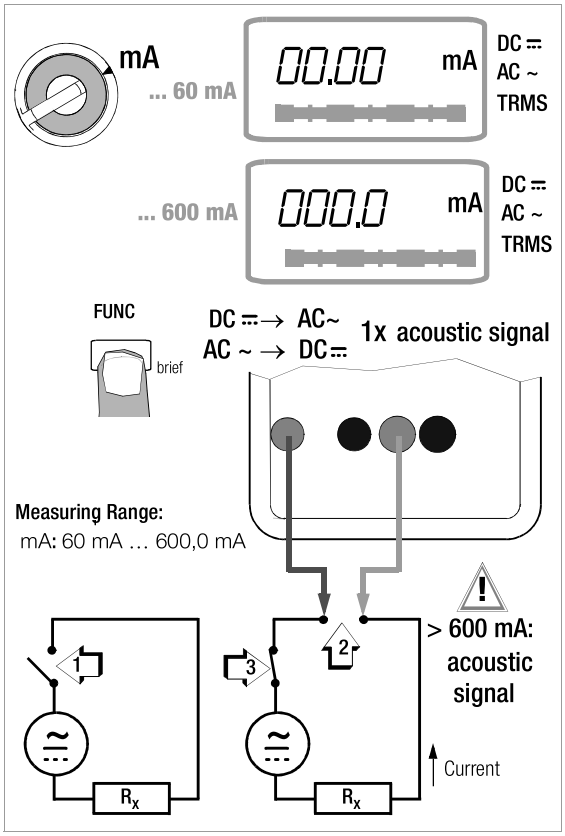
### 7.1 Sub-function Hz

- Turn the **rotary selector switch** to V ~
- Briefly press the **FUNC** multifunction key to display the frequency (max. 2_kHz) of the AC voltage.
- Press the **FUNC** key once again to quit the Hz function.

## 8 Current Measurement

- First disconnect supply power from the measuring circuit or the consuming device, and discharge any included capacitors.
- Select the A ⎓ range with the **rotary selector switch** for current greater than 600 mA, or the mA ⎓ range for current less than 600 mA. Activate the **highest measuring range first** when measuring current of an unknown magnitude.
- Select the current type appropriate for the measured quantity by briefly pressing the **FUNC** key. Each time the key is pressed, DC and AC are alternately selected, and switching is acknowledged with an acoustic signal. The selected current type is indicated at the LCD by means of the DC and AC symbols.
  DC current is always active immediately after range selection with the **rotary selector switch**.
- Securely connect the measuring instrument to the consuming device in series as shown (without transfer resistor).






**Notes Regarding Current Measurement:**

- The measuring circuit must be mechanically stable and must be secured against accidental interruption. Select conductor cross-sections and connectors such that no overheating occurs.
- An intermittent acoustic signal warns the operator if the measured value exceeds the upper range limit in the 600 mA and 10 A measuring ranges.
- Measuring ranges up to 600 mA are protected against short-circuit current of up to 25 A with an FF 1.6 / 1000 V fuse link in combination with power diodes. The fuse has a breaking capacity of 10 kA at a nominal voltage of 1000 V ~ and ohmic load.
- The 6A and 10 A current measuring ranges are protected with a 10 A / 1000 V fuse link. The fuse has a breaking capacity of 30 kA at a nominal voltage of 1000 V ~ and ohmic load.
- If one of the fuses blows, this condition is indicated at the LCD as soon as a measured quantity with a voltage of greater than 4 V is applied to the corresponding connector jacks.The following symbol appears at the digital display in this case: ⊣▭⊢ .
- If a fuse blows, eliminate the cause of overload before placing the instrument back into service!
- Refer to chapter 15 “Maintenance”, regarding fuse replacement.

**Zero Balancing Δ REL during Current Measurement**

You can select the reference point in the mA AC / DC and A AC / DC measuring range:

➪ Plug the measuring cables into the instrument and connect the free ends to each other.

➪ After selecting the measuring range, briefly press the two **HOLD** and **MAN / AUTO** keys.

The instrument acknowledges zero balancing with an acoustic signal and „0“ (+ 1 digit) and Δ REL appears at the LCD, depending on the measuring range. The voltage displayed at the moment the key is pressed is automatically substracted from all subsequent measured values.

Zero balancing can be deleted:

– by briefly pressing the **MAN / AUTO** key, which is acknowledged with an acoustic signal,

– by switching the instrument off.

### 8.1 Measuring Alternating Current with (Clip-On) Current Transformers

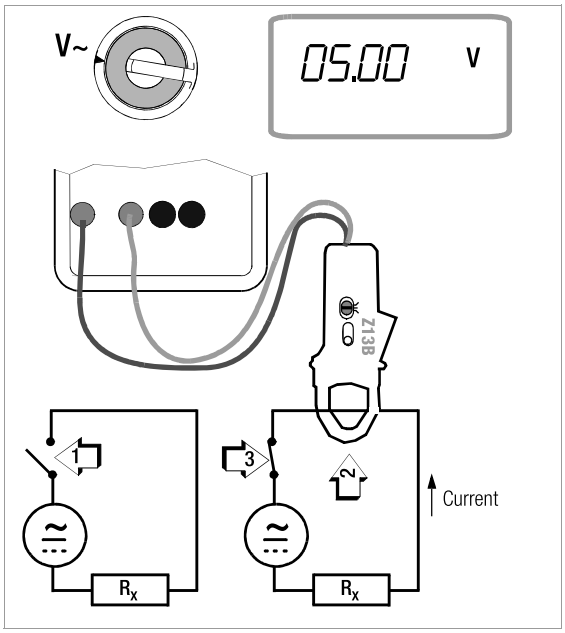
#### 8.1.1 Transformer Output mA / A

**Attention!**
If current transformers are operated without being connected at the secondary side (e.g. as a result of defective or missing cables, a blown device fuse or incorrect connection), dangerously high voltages may occur at the connector jacks. For this reason, make sure that the measuring instrument's current path and the transformer's secondary coil connected to the instrument constitute an uninterrupted circuit, and connect this circuit to the ⊥ and mA or A jacks.

Maximum allowable operating voltage is equal to the current transformer's nominal voltage. Do not forget to consider the transformer's transformation ratio and additional display error when reading measured values.

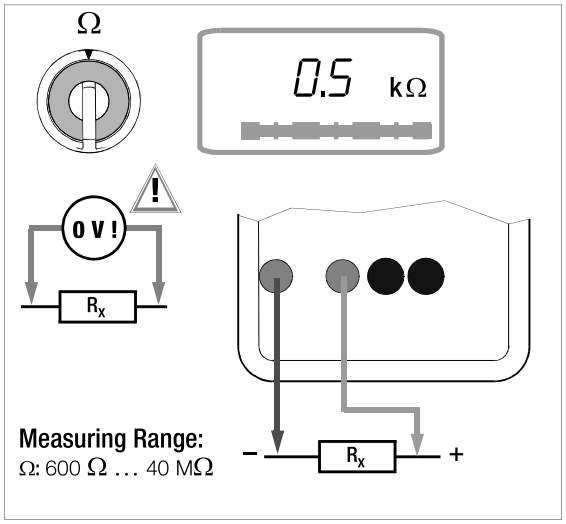
#### 8.1.2 Transformer Output V

Some transformers are equipped with a voltage output (designation mV/A). The secondary terminals must thus be connected to ⊥ and V.




## 9 Resistance Measurement

- ➪ Make sure that the device under test is voltage-free. Interference voltages distort measurement results!
- ➪ Set the **rotary selector switch** to Ω.
- ➪ Connect the device under test as shown.




**Zero Balancing Δ REL in the entire resistance measuring range**

Cable and contact resistances can be eliminated during resistance measurement by means of zero balancing:

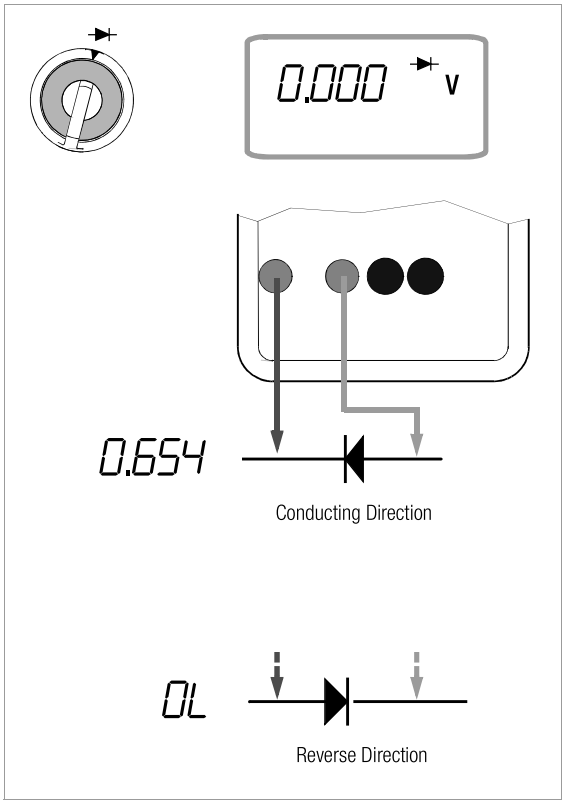
- ➪ Plug the measuring cables into the instrument and connect the free ends to each other.
- ➪ Press the **MAN / AUTO** and **HOLD** keys after selecting the measuring range.
  The instrument acknowledges zero balancing with an acoustic signal and „0" (+1 digit) and Δ REL appears at the LCD, depending on the measuring range. The resistance value measured at the moment the key is pressed is automatically subtracted from all subsequent measured values.

Zero balancing can be deleted:

- – by briefly pressing the **MAN / AUTO** key, which is acknowledged by an acoustic signal,
- – by switching the instrument off.

## 10 Continuity and Diode Testing

- Make sure that the device under test is voltage-free. Interference voltages distort measurement results!
- Set the **rotary selector switch** to ⊣◀.
- Connect the device under test as shown.




**Conducting Direction and/or Short-Circuit:**

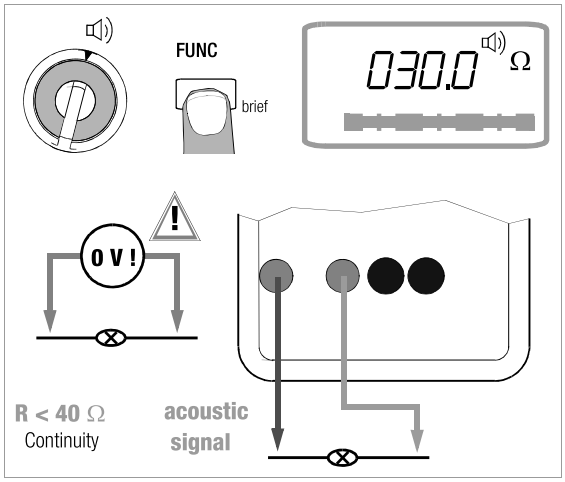
The instrument displays conducting-state voltage in volts. As long as voltage drop does not exceed the maximum display value of 1,999 V, several series connected components or reference diodes can be tested with a small reference voltage.

**Reverse Direction or Interruption:**

The measuring instrument indicates overflow “OL”.

**Note!**

Resistors and semiconductors which are connected in parallel to the diode distort measurement results!




**Sub-function Continuity Test with Acoustic Signal**

If the sub-function “continuity test with acoustic signal” is activated, a continuous acoustic signal is generated by the instrument within a display range of R < 40.

**Acoustic Signal ON:**

- Briefly press the **FUNC** key.
  Activation is acknowledged with an acoustic signal.
  The 🔊 symbol appears at the display as well.

**Acoustic Signal OFF:**

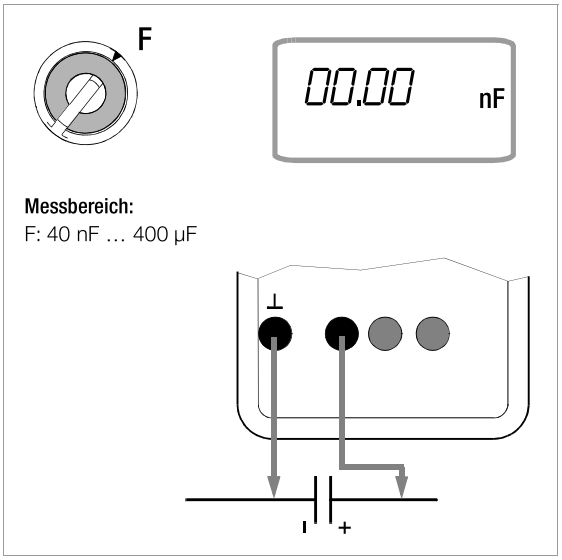
- Briefly press the **FUNC** key once again.
  Deactivation is acknowledged with an acoustic signal.
  The 🔊 symbol is cleared from the display.

The acoustic signal function is always inactive immediately after the “continuity test” function has been selected with the **rotary selector switch**. The acoustic signal can be activated and deactivated by repeatedly and briefly pressing the **FUNC** key. If the key is pressed and held, the acoustic signal is always deactivated, which is acknowledged with two acoustic signals.

## 11 Capacitance Measurement

- Make sure that the device under test is voltage-free. Interference voltages distort measurement results!
- Turn the rotary switch to the “F” position.
- Connect the (discharged!) device under test to the and V jacks with the measurement cables

**Note!**
The “–“ pole of polarized capacitors must be connected to the „⊥“ jack.
Resistors and semiconductor paths connected in parallel to the capacitor distort measurement results!




## 12 Frequency Measurement – Duty Cycle Measurement

- Turn the rotary switch to the Hz position.
- Apply the measured quantity as described under voltage measurement.
- Smallest measurable frequencies and maximum allowable voltages are listed in chapter 14 “Characteristic Values”.

### 12.1 Duty Cycle Measurement

The pulse-period ratio can be ascertained for square-wave signals with the duty cycle measurement.

- Turn the rotary swith to Hz position
- Briefly press the multifunction **FUNC** key twice. The instrument is switched to duty cycle measurement. The duty cycle, i.e. the pulse duration of a signal as a percentage, is displayed at the LCD.

$$\text{Duty Cycle (\%)} = \frac{\text{Pulse Duration}}{\text{Period}} \bullet 100$$

**Note!**
The applied frequency must remain constant during duty cycle measurement.

### 12.2 RPM Measurement

RPM is measured by acquiring pulses. The number of measurable pulses per revolution varies depending upon the type of engine.

- Set the rotary switch to **Hz.**
- Press the multifunction key **FUNC** twice until unit of measure RPM appears.

The measured value then appears, for example “244.3 RPM”.

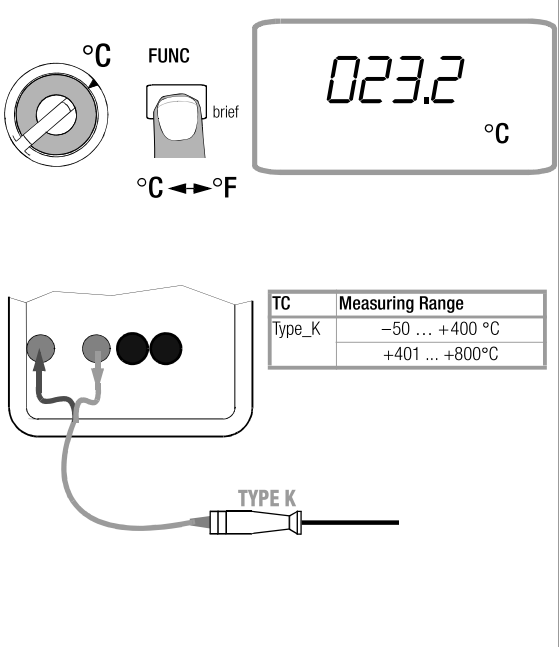
## 13 Temperature Measurement

The multimeter provides for the measurement of temperatures within a range of – 50 °C to + 800 °C with the help of a type K temperature sensor.

- ➪ Set the **rotary selector switch** to „°C“.
- ➪ Connect the sensor to the two accessible jacks. The device indicates the measured temperature in °C at the digital display.
- ➪ Briefly press the **FUNC** key to switch between °C and °F.

**Note!**

The cold junction temperature (reference temperature) is measured with a Pt100 temperature sensor inside the instrument. It is displayed when the measuring input is short-circuited. Due to internal heating or a change from warm to cold environment or vice versa, the reference temperature may differ from the ambient temperature.




| TC | Measuring Range |
|---|---|
| Type_K | –50 … +400 °C |
| | +401 ... +800°C |

## 14 Characteristic Values

| Meas. Function | Measuring Range | | Resolution 6000 | Input Impedance ⎓ | Input Impedance ~ | Intrinsic Uncertainty at Max. Resolution under Reference Conditions ±(... % rdg. + ... d) ⎓ | Intrinsic Uncertainty at Max. Resolution under Reference Conditions ±(... % rdg. + ... d) ~ [5] | Overload Capacity [1] Value | Overload Capacity [1] Time | Meas. Function |
|---|---|---|---|---|---|---|---|---|---|---|
| **V** | 600 mV | | 100 µV | 10 MΩ // < 40 pF | 8.1 MΩ // 50 pF | 0.5 + 5 | 1 + 5 | 1000 V DC AC eff Sinus | Cont. | **V** |
| | 6 V | | 1 mV | 5.2 MΩ // < 40 pF | 4.6 MΩ // 50 pF | 0.5 + 5 | | | | |
| | 60 V | | 10 mV | 5 MΩ // < 40 pF | 4.4 MΩ // 50 pF | 0.5 + 5 | | | | |
| | 600 V | | 100 mV | 5 MΩ // < 40 pF | 4.4 MΩ // 50 pF | 0.5 + 5 | | | | |
| | 1000 V | | 1 V | 5 MΩ // < 40 pF | 4.4 MΩ // 50 pF | 0.5 + 5 | | | | |
| | | | | **Voltage drop at approx. range limit** | | | | | | |
| | | | | ⎓ | ~ | ⎓ | ~ [5] | | | |
| **A** | 60 mA | | 10 µA | 100 mV | 100 mV | 1.0 + 5 (> 10 D) | 1.5 + 5 (> 10 D) | 1.0 A | Cont. | **A** |
| | 600 mA | | 100 µA | 700 mV | 700 mV | | | | | |
| | 6 A | | 1 mA | 200 mV | 200 mV | | | 10 A [4] | Cont. | |
| | 10 A | | 10 mA | 300 mV | 300 mV | | | | | |
| | | | | **Open-circuit voltage** | **Meas. current at range limit** | **±(... % rdg. + ... d)** | | | | |
| Ω | 600 Ω | | 100 mΩ | max. 1 V | max. 250 µA | 1 + 5 [2] | | 1000 V DC AC eff Sinus | max. 10 s | Ω |
| | 6 kΩ | | 1 Ω | max. 1 V | max. 100 µA | 0.7 + 3 | | | | |
| | 60 kΩ | | 10 Ω | max. 1 V | max. 12 µA | 0.7 + 3 | | | | |
| | 600 kΩ | | 100 Ω | max. 1 V | max. 1,2 µA | 0.7 + 3 | | | | |
| | 6 MΩ | | 1 kΩ | max. 1 V | max. 120 nA | 0.7 + 3 | | | | |
| | 40 MΩ | | 10 kΩ | max. 1 V | max. 50 nA | 2.0 + 3 | | | | |
| ⏛ | 2 V | | 1 mV | max. 3 V | | 1.0 + 5 | | | | ⏛ |
| 🔊 | 600 Ω | | 0.1 Ω | max. 1 V | max. 250 µA | 1.0 +5 | | | | 🔊 |
| | | | | | | **±(... % rdg. + ... K)** | | | | |
| °C | TYP K | -50,0 ... +400 °C | 0,1 °C | | | 1.0 + 5 K [3] | | 1000 V DC/AC eff Sinus | max. 10 s | °C |
| | | +401 ... +800 °C | 0,1 °C | | | 5.0 + 7 K [3] | | | | |
| | | | | **Power limit** | | **±(... % rdg. + ... d)** | | | | |
| Hz | 100 Hz | | 0,1 Hz | 3 x $10^6$ V x Hz @ U > 100 V | | 0.1 + 2 | | 1000 V | max. 10 s | Hz |
| V ~ | 1000 Hz | | 1 Hz | | | | | | | V ~ |
| Hz | 100 Hz | | 0,1 Hz | 3 x $10^6$ V x Hz @ U > 100 V | | 0.1 + 2 | | 1000 V | max. 10 s | Hz |
| | 1000 Hz | | 1 Hz | | | | | | | |
| | 1000 kHz | | 1 kHz | | | | | | | |
| | | | | **Power limit** | | | | | | |
| % | 30 Hz ... 1KHz: 2,0 ... 98,0 | | | 3 x $10^6$ V x Hz @ U > 100 V | | 0.2% v.MUL + 8 D | | 1000 V | max. 10 s | % |
| | 1 kHz ... 4 kHz: 5,0 ... 95,0 | | | | | 0.2% v.MUL/kHz + 8 D | | | | |
| | 40 kHz ... 10 kHz:10,0 ...90,0 | | | | | 0.2% v.MUL + 8 D | | | | |
| | | | | | | | | | | |
| Rpm | 60 ... 99.99 k | | 1 Rpm | | | ± 2 Rpm | | 1000 V | max. 10 s | Rpm |
| | | | | **Discharge Resistance** | | **±(... % rdg. + ... MR)** | | | | |
| F | 40 nF | | 10 pF | 10 MΩ | | 2.0 + 10 with zero active | | 1000 D DC AC | max. 10 s | F |
| | 400 nF | | 100 pF | 1 MΩ | | 1.0 + 6 | | | | |
| | 4 µF | | 1 nF | 100 MΩ | | 1.0 + 6 | | | | |
| | 40 µF | | 10 nF | 12 MΩ | | 2.5 + 6 | | | | |
| | 400 µF | | 100 nF | 3 MΩ | | 5.0 + 6 | | | | |

1) At 0 °C ... + 40 °C
2) with zero balancing, + 35 digits without zero balancing
3) without sensor
4) 12 A 5 minutes, 16 A 30 seconds
5) 1 ... 35 d from the zero point due to TRMS converter when probe tips are short-circuited

**Key**

rdg. = reading (measured value); d = digit
MUL = upper range limit; MR = measuring range

## Influencing Quantities and Influence Error

| Influencing Quantity | Sphere of Influence | Measured Quantity / Measuring Range | Influence Error [1] ±(... % rdg. + ... digits) |
|---|---|---|---|
| Temperature | 0 °C ... +21 °C and +25 °C ... +40 °C | 600 mV ⎓ | 1.0 + 3 |
| | | 6 ... 600 V ⎓ | 0.15 + 1 |
| | | 1000 V ⎓ | 0.2 + 1 |
| | | V ∼ | 0.4 + 2 |
| | | 0 Ω [2] | 0.15 + 2 |
| | | 600 Ω [2] | 0.25 + 2 |
| | | 6 kΩ ... 6 MΩ | 0.15 + 1 |
| | | 40 MΩ | 1.0 + 1 |
| | | mADC, ADC | 0.5 + 1 |
| | | mAAC, AAC | 0.75 + 1 |
| | | – 50 ... + 200 °C | 0.5 K + 2 |
| | | + 200 ... + 400 °C | 0.5 + 2 |
| Measured Quantity Frequency | > 30 Hz ... 45 Hz | A ∼ | 2.0 + 10 |
| | > 65 Hz ... 1 kHz | 60 / 600 mA / 6 A | 1.5 + 10 |
| | | 10 A | 2 + 10 |
| | > 30 Hz ... 45 Hz | 600 mV | 3 + 10 |
| | | 6 / 60 /600 V | 2.5 + 10 |
| | | 1000 V | 3.5 + 20 |
| | > 65 Hz ... 500 Hz | 600 mV | 35 + 20 |
| | > 65 Hz ... 800 Hz | 6 / 60 V | 2.5 + 10 |
| | | 600 V | 3 + 20 |
| | | 1000 V | 3.5 + 20 |

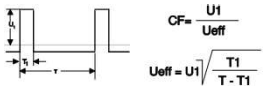
| Influencing Quantity | Sphere of Influence | Measured Quantity / Measuring Range | Influence Error |
|---|---|---|---|
| Battery Voltage | ⊣⊢ [3] ... < 2.9 V > 3.1 V ... 3.6 V | V ⎓ | ± 2 Digits |
| | | V ∼ | ± 4 Digits |
| | | A ⎓ | ± 4 Digits |
| | | A ∼ | ± 6 Digits |
| | | 60 Ω / 600 Ω / °C | ± 4 Digits |
| | | 6 kΩ ... 40 MΩ | ± 3 Digits |
| Relative Humidity | 75% 3 days Instrument off | V ≃ A ≃ Ω °C | 1 x intrinsic uncertainty |
| HOLD | — | | ± 1 Digits |
| MIN / MAX | — | V ≃ , A ≃ | ± 2 Digits |

1) For temperature: specified error valid starting with temperature changes as of 10 K. For frequency: specified error valid starting with display values as of 300 digits.
2) With zero balancing
3) After the ⊣⊢ symbol appears at the display

| Influencing Quantity | Sphere of Influence | Measuring Range | Damping |
|---|---|---|---|
| Common Mode Interference Voltage | Interference quantity max. 600 V ∼ | V ⎓ | > 120 dB |
| | Interference quantity max. 600 V ∼ 50 Hz, 60 Hz sine | 6 V ∼, 60 V ∼ | > 80 dB |
| | | 600 V ∼ | > 70 dB |
| Series Mode Interference Voltage | Interference quantity: V ∼ , respective nominal value of the measuring range, max. 600 V ∼, 50 Hz, 60 Hz sine | V ⎓ | > 50 dB |
| | Interference quantity max. 600 V — | V ∼ | > 110 dB |

### Crestfaktor CF

Test signal: Rectangle 55 Hz, no DC component




| Influencing Quantity | Sphere of Influence | Measured Quantity / Measuring Range | Influence Error |
|---|---|---|---|
| Crest factor CF | 1.5 < CF ≤ 2 | 6 V, 60 V, 600 V, 1000 V ∼ | ±1 % rdg. |
| | 2 < CF ≤ 4 | | ±5 % rdg. |

The admissible crest factor CF of the alternating quantity to be measured depends on the display value.
Crest factor 4 at the end of range, it is increased accordingly when the range is reduced. However, due to input protection, voltage is limited to 1000 V, therefore the admisible crest factor in the 600 V ranges is half as high.

When the waveform is unknown, measurement is to be performed with manual range selection in the case of higher frequency signals.

Power limiting: voltage x frequency max. $3 \times 10^6$ V x Hz.

### Response Time (after manual range selection)

| Measured Quantity/ Measuring Range | Response Time | | Measured Quantity Step Function |
|---|---|---|---|
| | Analog Display | Digital Display | |
| V ⎓, V ∼, A ⎓, A ∼ | 0.7 s | 1.5 s | from 0 to 80% of the upper range limit |
| 600 Ω ... 6 MΩ | 1.5 s | 2 s | from ∞ to 50% of the upper range limit |
| 40 MΩ | 4 s | 5 s | |
| ⊣◀ | — * | 1.5 s | |
| 🔊 | — * | < 50 ms | |
| °C | — * | max. 3 s | from 0 to 50% of the upper range limit |
| F | — * | max. 5 | |

* without bargraph

### Reference Conditions

| | |
|---|---|
| Ambient temperature | + 23 °C ± 2 K |
| Relative humidity | 40 % ... 60 % |
| Measured quantity frequency | 45 Hz ... 65 Hz |
| Measured quantity waveshape | sinusoidal |
| Battery voltage | 3 V ± 0.1 V |

### Display

LCD panel (65 mm x 30 mm) with analog and digital display including unit of measure, type of current and various special functions

Analog:

| | |
|---|---|
| Display | LCD scale with pointer |
| Scale length | 55 mm in all ranges |
| Scaling | 0 ... ± 60 with 61 scale divisions in all ranges |
| Polarity display | With automatic switching |
| Overflow display | Triangle |
| Measuring rate | 30 measurements per second |

Digital:

| | |
|---|---|
| Display / char. height | 7-segment characters / 15 mm |
| Number of places | $3^6/_7$-place ≙ 6000 steps |
| Overflow display | "**OL**" appears |
| Polarity display | "–" sign is displayed if plus pole is connected to "⊥" |
| Measuring rate | 3 measurements per second |

### Power Supply

| | |
|---|---|
| Battery | 2 x 1.5 V AA size batteries alkaline manganese per IEC LR6 or equivalent rechargeable NiCd battery |
| Service life | With alkaline manganese: approx. 750 hours for V ⎓, A ⎓ approx. 200 hours for V ∼, A ∼ |
| Battery test | ⊣⊢ is displayed automatically if battery voltage drops to below approx. 2.1 V. |

### Electrical Safety

| | |
|---|---|
| Safety class | II per IEC 61010-1:2010/ DIN EN 61010-1:2011/ VDE 0411-1:2011 |
| Overvoltage category | 1000 V CAT III, 600 V CAT IV |
| Nominal voltage | 1000 V |
| Fouling factor | 2 |
| Test voltage | 6.7 kV~ per IEC 61010-1:2010/ DIN EN 61010-1:2011 |

### Electromagnetic Compatibility (EMC)

| | |
|---|---|
| Interference emission | EN 61326-1: 2013 class B |
| Interference immunity | EN 61326-1: 2013<br>EN 61326-2-1: 2013 |

### Fuses

| | |
|---|---|
| Fuse links for all ranges up to 600 mA | FF(UR) 1.6 A/1000 V; 6.3 mm x 32 mm, switching capacity: 10 kA at 1000 V~ with ohmic load, protects all current measuring ranges up to 600 mA in combination with power diodes |
| Fuse links for all ranges up to 10 A | FF(UR) 10 A/1000 V; 10 mm x 38 mm, switching capacity: 30 kA at 1000 V with ohmic load, protects 6 A and 10 A ranges to 600 V Refer to chapter 15 "Maintenance", regarding fuse manufacturers and types. |

### Ambient Conditions

| | |
|---|---|
| Accuracy range | 0 °C ... + 40 °C |
| Operating temperature | –10 °C ... + 50 °C |
| Storage temperature | – 25 °C ... + 70 °C without batteries |
| Relative humidity | 45 ... 75%, no condensation allowed |
| Elevation | to 2000 m |
| Deployment | indoors only, except within specified ambient conditions |

### Mechanical Design

| | |
|---|---|
| Protection | IP 40<br>(IP 54 special type **WORLD_IS**)<br>per DIN VDE 0470 part 1 / EN 60529 |

Extract from table on the meaning of IP codes

| IP XY (1st digit X) | Protection against foreign object entry | IP XY (2nd digit Y) | Protection against the penetration of water |
|---|---|---|---|
| 0 | not protected | 0 | not protected |
| 1 | ≥ 50.0 mm dia. | 1 | vertically falling drops |
| 2 | ≥ 12.5 mm dia. | 2 | vertically falling drops with enclosure tilted 15° |
| 3 | ≥ 2.5 mm dia. | 3 | spraying water |
| 4 | ≥ 1.0 mm dia. | 4 | splashing water |

| | |
|---|---|
| Dimensions | 84 mm x 195 mm x 35 mm |
| Weight | approx. 350 gr. with battery |

## 15 Maintenance

**Attention!**
**Disconnect the instrument from the measuring circuit before opening to replace batteries or fuses!**

### 15.1 Battery

Make sure that no battery leakage has occurred before initial start-up, and after long periods of storage. Continue to inspect the batteries for leakage at short, regular intervals.

If battery leakage has occurred, carefully and completely clean the electrolyte from the instrument with a damp cloth, and replace the batteries before using the instrument.

If the ⊣⊢ symbol appears at the display , the batteries should be replaced as soon as possible. You can continue working with the instrument, but reduced measuring accuracy may result.

The instrument requires 2 x 1.5 V AA size batteries or two equivalent NiCd rechargeable batteries.

#### Replacing the Battery

- Set the instrument face down onto a flat working surface, loosen the two screws at the back and lift off the housing base, starting at the bottom. The housing top and housing base are held together with the help of snap hooks at the top front.
- Remove the batteries from the battery compartment.
- Insert two new 1.5 V AA size batteries into the battery compartment, making sure that the plus and minus poles match up with the provided polarity symbols.
- Important for reassembly: First set the housing base onto the housing top and align accurately (see photo below). Then press the two housing halves together, first at the bottom front (a), and then at the top front (b).


- Secure the housing base with the two screws.
- Please dispose of depleted batteries in accordance with environmental protection regulations!

### 15.2 Fuses

If one of the fuses blows, this condition is displayed at the LCD as soon as a measured quantity with a voltage of greater than 4 V is applied to the corresponding connector jacks. The following symbol appears at the digital display in this case: ⊣▭⊢ .

The 16 A fuse interrupts the 6 A and 10 A ranges, and the 1.6 A fuse interrupts all other current measuring ranges. All other measuring ranges remain functional.

If a fuse should blow, eliminate the cause of overload before placing the instrument back into service!

#### Replacing the Fuse

- Open the instrument as described under “Replacing the Battery”.
- Remove the blown fuse with the help of an object such as a test probe, and replace it with a new fuse.

#### The following fuses are approved for use:

– For current measuring ranges up to 600 mA:
Type FF 1.6 A / 1000 V AC (10 kA),
6.3 mm x 32 mm

– For 6 A and 10 A current measuring ranges:
FF 10 A/1000 V AC (30 kA),
10 mm x 38 mm

**Attention!**
Use specified fuses only! If fuses with other blowing characteristics, other current ratings or other breaking capacities are used, the operator is placed in danger, and protective diodes, resistors and other components may be damaged.

The use of repaired fuses or short-circuiting the fuse holder is prohibited.

### 15.3 Housing

No special maintenance is required for the housing. Keep outside surfaces clean. Use a slightly dampened cloth for cleaning. Avoid the use of cleansers, abrasives and solvents.

#### Device Return and Environmentally Compatible Disposal

The **instrument** is a category 9 product (monitoring and control instrument) in accordance with ElektroG (German Electrical and Electronic Device Law). This device is subject to the RoHS directive. Further-more, we make reference to the fact that the current status in this regard can be accessed on the

search term WEEE.

We identify our electrical and electronic devices in accordance with WEEE 2012/19/EU and ElektroG with the symbol shown to the right per DIN EN 50419.

These devices may not be disposed of with the trash. Please contact our service department regarding the return of old devices.
If you use **batteries** or **rechargeable batteries** in your instrument or accessories which no longer function properly, they must be duly disposed of in compliance with the applicable national regulations.
Batteries or rechargeable batteries may contain harmful substances or heavy metal such as lead (PB), cadmium (CD) or mercury (Hg).
They symbol shown to the right indicates that batteries or rechargeable batteries may not be disposed of with the trash, but must be delivered to collection points specially provided for this purpose.


## 16 Recalibration

The respective measuring task and the stress to which your measuring instrument is subjected affect the ageing of the components and may result in deviations from the guaranteed accuracy.

If high measuring accuracy is required and the instrument is frequently used in field applications, combined with transport stress and great temperature fluctuations, we recommend a relatively short calibration interval of 1 year. If your measuring instrument is mainly used in the laboratory and indoors without being exposed to any major climatic or mechanical stress, a calibration interval of 2-3 years is usually sufficient.

During recalibration* in an accredited calibration laboratory (DIN EN ISO/IEC 17025) the deviations of your instrument in relation to traceable standards are measured and documented. The deviations determined in the process are used for correction of the readings during subsequent application.

We are pleased to perform DAkkS or factory calibrations for you in our calibration laboratory. Please visit our website at

Calibration Center *or* → FAQs → Calibration questions and answers).

By having your measuring instrument calibrated regularly, you fulfill the requirements of a quality management system per DIN EN ISO 9001.

* Verification of specifications or adjustment services are not part of the calibration. For products from our factory, however, any necessary adjustment is frequently performed and the observance of the relevant specification is confirmed.

## 17 Accessories

### 17.1 General

The extensive accessories available for our measuring instruments are checked for compliance with currently valid safety regulations at regular intervals, and are expanded as required for new applications. Currently up-to-date accessories which are suitable for your measuring instrument are listed at the following web address along with photo, order number, description and, depending upon the scope of the respective accessory, data sheet and operating

(Products → Measuring Technology – Portable → Multimeter Accessories )
or
(Products → Measuring Technology – Portable → Digital Multimeters → **METRA HIT** ... → ◢ Accessories).

### 17.2 Technical Data for Measurement Cables (included: KS17-2 safety cable set)

**Electrical Safety**

| | | | |
|---|---|---|---|
| **Maximum Rated Voltage** | **600 V** | **1000 V** | **1000 V** |
| **Measuring Category** | **CAT IV** | **CAT III** | **CAT II** |
| **Maximum Rated Current** | **1 A** | **1 A** | **16 A** |
| **with** safety cap applied | • | • | — |
| **without** safety cap applied | — | — | • |

**Ambient Conditions (EN 61010-031)**

| | |
|---|---|
| Temperature | –20 °C ... + 50 °C |
| Relative humidity | max. 80% |
| Pollution degree | 2 |

**Application KS17-2**

**Attention!**
**Please observe the maximum values of the electrical safety of the device.**
In conformity with standard DIN EN 61010-031, measurements in an environment according to measuring category III and IV may only be performed with the safety cap applied to the test probe of the measurement cable.

For establishing contact in 4 mm jacks you have to remove the safety cap by levering out the snap lock of the safety cap with another sharp object (e.g. the second test probe).

## 18 Repair and Replacement Parts Service, Calibration Center* and Rental Instrument Service

If required please contact:

GMC-I Service GmbH
**Service Center**

This address is only valid in Germany.
Please contact our representatives or subsidiaries for service in other countries.

* **DAkkS Calibration Laboratory for Electrical Quantities D-K-15080-01-01 accredited per DIN EN ISO/IEC 17025**

Accredited quantities: direct voltage, direct current value, direct current resistance, alternating voltage, alternating current value, alternating current active power, alternating current apparent power, DC power, capacitance, frequency, temperature

**Competent Partner**

GMC-I Messtechnik GmbH is certified in accordance with DIN EN ISO 9001.

Our DAkkS calibration laboratory is accredited by the Deutsche Akkreditierungsstelle GmbH (National accreditation body for the Federal Republic of Germany) in accordance with DIN EN ISO/IEC 17025 under registration number D-K-15080-01-01.

We offer a complete range of expertise in the field of metrology: from **test reports** and **factory calibration certificates**, right on up to **DAkkS calibration certificates.**

Our spectrum of offerings is rounded out with free **test equipment management.**

An on-site **DAkkS calibration station** is part of our service department. If errors are discovered during calibration, our specialized personnel are capable of completing repairs using original replacement parts.

As a full service calibration lab, we can calibrate instruments from other manufacturers as well.

**DAkkS Calibration Certificate Reprints (upon request)**

If you order a DAkkS calibration certificate reprint for your instrument, please provide us with the reference numbers indicated in the upper and lower most fields of the calibration seal. We do not need the instrument's serial number.

## 19 Manufacturer's Guarantee

All METRAHIT digital multimeters and calibration instruments are guaranteed for a period of 3 years after shipment. The manufacturer's guarantee covers materials and workmanship. Damages resulting from use for any other than the intended purpose or operating errors, as well as any and all consequential damages, are excluded.

The calibration certificate confirms that the product conformed to the specified technical data at the time of calibration. We guarantee the observance of the specified technical data within the admissible tolerance limits for a period of 12 months from delivery.

## 20 Product Support

If required please contact:

GMC-I Messtechnik GmbH
**Hotline Produktsupport**